



Syed Arif Kamal* and S. A. Khan[#]

**University of Karachi, Department of Mathematics, SF-Growth-and-Imaging Laboratory and
Department of Health, Physical Education and Sports Sciences, Karachi 75270, Pakistan**

profdrakamal@gmail.com

ORIGINAL ARTICLE

HAIRSTYLE, FOOTWEAR AND CLOTHING FOR GYMNASTIC ACTIVITIES IN THE PRIMARY-SCHOOL SETTING

Abstract

The authors recommend gymnastic kits for primary classes, while considering drawbacks of existing clothing choices. Safety, ease of changing, cost, weather considerations and social constraints were put together to propose a practical gym kit for school-based-gymnastic activities. Age-wise recommendations are given for activity-appropriate hairstyle, footwear and clothing for primary classes for both indoor and outdoor sessions. Gymnastics should be done barefoot (indoors) and in pure-cotton socks and plimsolls (sneakers) outdoors, where barefoot exercises are not possible, with boys, unclothed from the waist up, in briefs, legs uncovered from upper thighs to feet, or figure-hugging half pants, reaching just below knees; girls, unclothed from the waist up, in knickers (panties), legs uncovered from upper thighs to feet, or leotard (with stockings, if desired). Girls should tie their long hair in the form of (hair) bun to expose the upper-neck area. Boys should be required to wear athletic supporters under briefs. For training sessions, students are grouped in sections A, B and C — small children (sum of percentiles of height and mass below 50) placed in section A, children of medium build (sum 50 or above but below 150) in section B and big children (sum 150 or above) in section C. Within a section and its sub-sections, a uniform dress code should be implemented for participating in gymnastic practices.

Keywords: Age-wise recommendations, activity-appropriate kit, safety, physical training

*Prof. Dr. Syed Arif Kamal (<http://www.ngds-ku.org/kamal>) is Head, Anthromathematics Group, Project Director, the NGDS Pilot Project (<http://ngds-ku.org>), Professor of Mathematics, Interdepartmental Faculty in Department of Health, Physical Education and Sports Sciences and Dean, Faculty of Science, University of Karachi. He is a member of Subject Committee for Physical Education, Health and Sport Sciences of National Testing Service Pakistan.

[#]S. A. Khan holds MSc in Health and Physical Education and is associated with SF-Growth-and-Imaging Laboratory of University of Karachi.

INTRODUCTION

Gymnastics are defined as *exercises developing the muscles*, anatomy or grammar of locomotion — joint mobility and muscle tone, requiring agility, balance, control, coördination, flexibility, grace, physical strength and power. Fédération Internationale de Gymnastique (FIG) governs competitive gymnastic events and affiliates national governing bodies. ‘Gymnastics’ is derived from Greek adjective *γυμνός* (*gymnos*), which means ‘naked’. The related verb *γυμνάζω* (*gymnazo*) means ‘to train naked’. In ancient times, athletes exercised without clothing. Gymnastics became common in 1570s, from Latin *gymnasticus*, from Greek *gymnastikos* (skilled in/fond of bodily exercise) and *gymnazein* (to train/to exercise).

Combining anatomy and physiology, gymnastics deals with human-body-physiological functioning, for all-round harmonious development (Joseph, 1949), enhancing body image, developing spinal column and controlling obesity (Tuckson, 2013). The first author was fascinated by gymnastics as a teenager by watching perfect-10 (out of 10) performances of 14-year-old Romanian gymnast Nadia Elena Comăneci in 1976 Montréal Olympics, and in the following years by breathtaking performances of Ecaterina Szabo (Romania) and Mary Lou Ritten (United States). Later, he developed 3-D static (Kamal, 1996a), dynamic (Kamal, 1996b) and crystal-structure-concept-based (Kamal *et al.*, 2012) models of the human spinal column, which made him view gymnastics as an all-inclusive activity developing muscles and bones as well as strengthening skeleton. In primary-school curriculum, gymnastics is referred to as PT (Physical-Training). However, PT lesson includes a broader range of activities than are to be found in a gymnastics lesson. To drive maximum advantage from gymnastic-activities, the students should be dressed based on performance and safety considerations.

This paper expands on the ideas presented earlier (Kamal & Khan, 2014) about age-appropriate hairstyle, footwear and clothing for efficient (requiring the least amount of time spent in changing) and effective (rendering quality instruction) teaching of gymnastics, which allows the coach to view a gymnast's neck, shoulders, scapulae, body triangles, spinal outline from external auditory meatus to hip joint and spinal dimples, without obstruction. Students should be provided with numbered boxes, in which they can store their accessories for safe-keeping. The items, which are prohibited during gymnastic lessons include belt, bow, cap, Capri, cropped tops, dress shoes, (fancy and loose strings, straps, zippers in; silky) gym clothing, hair band, hair clips, hair pins, (all sort of) jewellery, leggings, miniskirt, scarf, shirt, shorts, skirt, socks (made of synthetic material), street shoes, T-shirt, tie, trousers, vest and watch (Figure 1).

<i>In Gymnastic Clothing</i>
Coloured Gym Clothing/Underwear (for training sessions)
Fancy Strings
Loose Strings
Silky Gym Clothing/Underwear
Straps
Zippers
<i>Other Accessories</i>
Belt
Bow
Cap
Capri
Cropped Tops
Dress Shoes
Hair Band
Hair Clips
Hair Pins
Jewelry (bangles, bracelet, brooch, chain, ear ring, finger ring, locket)
Leggings
Miniskirt
Scarf
Shirt
Shorts
Skirt
Socks (made of synthetic material)
Street Shoes
Tie
Trousers
T-shirt
Vest
Watch

Figure 1: Prohibited items during gymnastic activities

Table 1: Hairstyle and footwear for gender-segregated-training and public-performance sessions

Setting	Boys	Girls
Hairstyle for All Ages		
Indoors	Very short hair	Long hair — to be tied in the form of (hair) bun
Outdoors	Very short hair	Long hair — to be tied in the form of (hair) bun
Footwear for All Ages		
Indoors	Barefoot	Barefoot
Outdoors	Pure-cotton socks + plimsolls (sneakers)	Pure-cotton socks + plimsolls (sneakers)

Hairstyle and Footwear

Boys should have very short hair. Girls should tie long hair in the form of (hair) bun using pony (untied hair may get jumbled up in furniture/apparatus) leaving upper-neck area uncovered, so that teacher may visualize deviations from correct posture and cervical-area curvatures (Kamal *et al.*, 1998).

Boys and girls should do gymnastics (training as well as public-performance sessions) bare-foot, indoors. Where barefoot is not possible during outdoor gymnastic activities, the students should wear plimsolls (sneakers) with socks, both of them white in colour. Pure clean cotton socks should be worn in order to stay away from feet infections — disinfectant powder needs to be applied before putting on socks.

Table 1 describes hairstyle and footwear for boys and girls for participating in gymnastic activities.


Clothing

Children's clothing during physical activity is being discussed for a long time (Curtis, 1922). Gymnastic-clothing should not be loose enough to prevent the kit from getting caught into equipment, furnishings or fixtures. During headstand and summersault, baggy attire and loose

garments (*e. g.*, T-shirt) may come over students' faces, obstructing vision and causing accidents.

Further, gym kit should not have loose strings or straps. Loose garments, strings or straps may get tangled into asymmetric bars or vault. Zippers are, also, not allowed, as these items damage apparatus. Gym outfit should, also, not be too tight (at the waist and around thighs), prohibiting free movement as well as heating/irritation of genital areas — rationale for disallowing thongs. Gym apparel should be white/light-coloured having elastic bands at waistline/around thighs, good enough to hold the dress in place and prevent private-part exposure. Primary-school students get heated, quickly. 32-year ago, Committee on Sports Medicine of the American Academy of Pediatrics (1982) proposed, “clothing of exercising child should be light-weight, limited to one layer of absorbent material in order to facilitate evaporation of sweat and *expose as much skin as possible*.” Hence, the authors suggest that younger students exercise in minimal clothing (note meaning of gymnastics given in ‘introduction’ section). Additional benefits include:

- a) It should make the teacher aware of obese/wasted students.
- b) The students would be motivated to maintain balanced gait and improved body image.
- c) During outdoor exercises, performed in secluded grassy patches, air and sun exposure may provide students vitamin-D doses, helping prevent *rickets* and *tuberculosis* (early childhood), *scoliosis*, *kyphosis* and *lordosis* (later childhood and adolescence) and *osteoporosis* (old age). Guarded-graduated (guarded means overexposure surveillance; graduated implies systematic increase in exposure for body conditioning) approach should build up sun-exposure tolerance and common-cold resistance (*cf.* argument *j*) by producing melanin layer, which protects the student from skin cancer. During initial sun-exposure, bare body-parts should be covered by sunscreen having appropriate SPF (Sun-Protection Formula) value.

No food or drink 90 minutes before the start of a session.	
Upon arrival, students are subjected to stripped morning inspection — safety, hygiene and health (physical and mental) components; clothing worn from home stored in locker after security-check through X-ray scanner.	
Setting-up exercises, followed by light floor and structured activities, are performed in open air and sunshine so that the students get their required daily doses of vitamin D.	
During the above activities, students should have hair exposed (unbraided and separated, spread along backs), completely undressed except briefs or knickers (panties), barefoot, having backs toward the sun to protect eyes.	
Complete change of clothes for classroom lessons, gymnastic sessions and rest sessions.	
End-of-class exercises performed for 5 minutes.	
For gymnastic sessions, the students change into prescribed kit for their respective age groups.	
Pre-departure inspection and handing over students to their parents.	

Figures 2a, b: (a) Typical routine of a day at gymnastic school; (b) a 5-year old boy, dressed in briefs, barefoot, stripped-to-waist, being helped to grab the bar

Figure 2a gives typical routine of a gymnastic-school day, which starts with sun exposure of body;

Figure 2b shows a boy performing gymnastics in the recommended kit.

- d) It gives the teacher a chance to observe unconscious posture/free movement.
- e) Students grow rapidly in this age group. Fitting gym kit, bought at the beginning of school year, becomes tight quickly, which is bad for circulation and restricts movement activities. Loose clothing looks shabby, besides being unsafe for apparatus activities.
- f) Younger students get sweaty much earlier compared to older ones. Gym kit donned during the entire period becomes sweat-soaked, causing skin infections, irritations and tan lines on shoulders/arms. Also, this practice does not allow body to breathe.
- g) During free play, sand, mud and water activities, upper portion of kit gets dirty. Last two activities may render upper garment wet and damp, causing students to catch colds/chest infections — this seems to be the main reason of worldwide family practices letting children remain undressed from the waist up inside homes, according to internet polls.
- h) During training sessions, undressing to underclothes instead of changing to kit saves money for economically weak parents. The saved money could be reallocated to enjoy vacations, pay sport-activity fees and purchase healthy foods.
- i) Japanese consider that students reared this way are better prepared to handle peer pressure; bullying and can take up challenges of a competitive work force. These students are more disciplined and

rarely resort to violence. Hikari Kindergarten located in Tokyo, Japan encourages students to undress from the waist up in school and while at home. Communities, in the past, like Sparta and Greece, adhered to similar practices.

- j) Nikitin children in the Moscow suburb are, also, raised this way. These children put on minimal clothes even in the coldest of winters. One of the Nikitin boys completed a university degree just when he was just 13-year old.
- k) For Buddhists, Hindus or Muslims, spiritual maturity is achieved, when male worshippers strip-to-waist and cover the upper body part with a loose sheet.
- l) Increased tactile stimulation, on back, arms and legs, helps students learn better. Our bodies are programmed to respond, positively, to touch. The process reduces stress response, increases level of oxytocin (a natural peptide responsible for promoting bonding), activates orbital-frontal cortex (area acknowledging pleasure, when one is exposed to pleasant smells) and enhances communication (Signy, 2012). A simple back rub is helpful for better night's sleep, according to *Journal of Holistic Nursing* — a three-minute, slow-stroke back massage increased nighttime sleep by about 36 minutes in dementia patients (Health Smart, 2013). Difficult concepts/words are understood better, if written on arms, back, feet, legs, neck, palms and soles, *etc.* Helen Keller sensed the words scribed on her palm. Atkinson *et al.* (1981) included a figure in their book, showing telephone image, converted into dot-pattern and projected on a blind woman's bare back, in the form of hundreds of tiny cones, vibrating against her back, allowing her to feel dot pattern and perceive image.

Burton (1977) observes, “If children wear clothing that permits an unlimited range of motion and allows for considerable tactile stimulation, movement experience is enhanced”. Gymnastics, conducted in underwear, is the most *efficient* (time saving — changing time minimized, which could be used in learning and teaching) and highly *effective* (quality teaching — allows teacher to observe body shape, form and outline of spinal column, contortions as well as gross- and fine-movement patterns) option for lower-primary-physical-education classes. Internet surveys indicated that parents from all over the world were extremely satisfied, if their primary-level children exercised in briefs or knickers (panties). This was common in England (Ministry of Education, 1952; 1953; Russell, 1975), Germany (Vendien & Nixon, 1968) and other European countries during twentieth century. Kirchner (1970) described adoption of strip-to-undergarment

procedure in American elementary (primary) schools, after establishing communication with parents, “When they saw their children changing, but more importantly, the type of activities and (the) learning included in the lessons, no one asked to change the procedure.” Changing time decreased to 4 minutes (from 12 minutes) after adopting the new procedure.

In the Pakistani-primary-school setting, it is impractical for students to change for gymnastics and shower:

- i) Arrangement of private space, where students can change completely for gym activity, would be difficult in primary schools. In our society, it is considered inappropriate to undress completely even in the presence of same gender.
- ii) Secluded shower stalls would be difficult to arrange in most primary schools; communal showers are not accepted in our culture.
- iii) Younger students might need supervision in managing hot water, may be difficult to arrange in all schools.

At the end of a gym session, the students should be given towels (preferably disposable) to rub their bodies so that sweat is wiped off before school clothing is worn back on. For hygiene reasons, towels should not be shared.

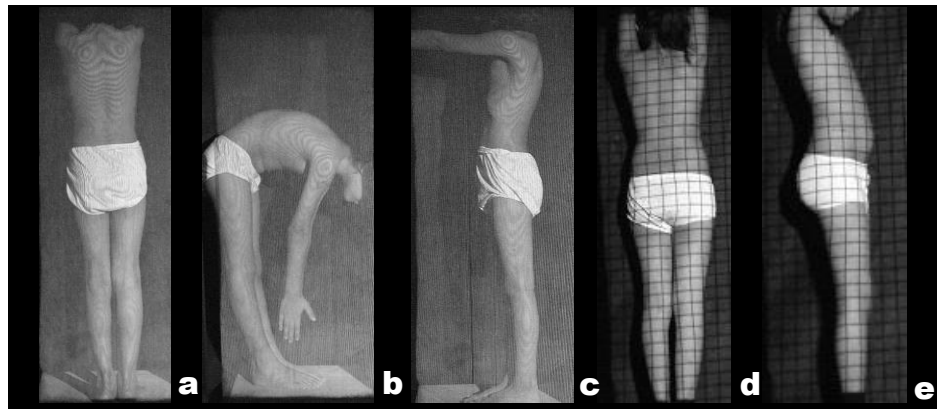
Recommendations

Boys should do gymnastics unclothed from waist up, younger ones clad in briefs only (legs bare from upper thighs to feet), whereas older students may put on figure hugging half-pants, terminating just below knees. Athletic supporter should be worn under briefs or figure hugging half-pants. These recommendations apply to both training and public-performance sessions. For training sessions of younger girls, suitable clothing is knickers (panties) only, stripped-to-waist, legs not covered from upper thighs to feet. For public-performance sessions, these girls may put on asymmetric leotard, with legs from upper thighs to feet as well as dominant arm (left arm for left-handed students and vice versa) and neck area, uncovered. Older girls may put on

leotard, exposing legs from upper thighs to feet. *Training leotards* must expose the entire neck, scapulae and spinal outline from external auditory meatus to hip joint, to facilitate visual and moiré examination (Akram & Kamal, 1991). Leotards could be worn with stockings by more mature students. Absolutely nothing should be allowed under leotard (no vest, no under garments). Disinfectant powder needs to be applied on areas to be covered by garments before putting on gym clothing. Younger girls may find leotard difficult to manipulate. Asymmetric leotard offers freedom of movement to preferred arm. However, structure of this garment is such that it does not allow complete exposure of the entire spinal column. Hence, it should be used only for public-performance sessions and not for training sessions. Also, asymmetric leotard may be more costly. Clothing recommendations for gender-segregated gymnastic-training sessions are listed in Table 2.

Table 2: Clothing for gender-segregated-gymnastic-training sessions

Setting	Boys	Girls
Boys should be wearing athletic supporter under briefs or figure-hugging half-pants		
Under 7		
Indoors	Section A: Briefs	Section A: Knickers (Panties)
	Section B: Briefs	Section B: Knickers (Panties)
	Section C: Briefs	Section C: Knickers (Panties)
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
Under 9		
Indoors	Section A: Briefs	Section A: Knickers (Panties)
	Section B: Briefs	Section B: Knickers (Panties)
	Section C: Briefs	Section C: Training leotard
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
Under 11		
Indoors	Section A: Briefs	Section A: Knickers (Panties)
	Section B: Briefs	Section B: Training leotard
	Section C: Figure-hugging half-pants	Section C: Training leotard — with stockings
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
11+		
Indoors	Section A: Figure hugging half-pants	Section A: Training leotard — with stockings
	Section B: Figure hugging half-pants	Section B: Training leotard — with stockings
	Section C: Figure hugging half-pants	Section C: Training leotard — with stockings
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	



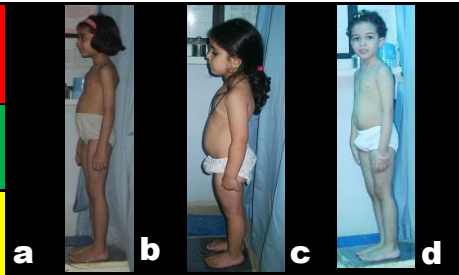
Figures 3a-e: Moiré fringe topography of children in various positions (a) hands stretched above head, (b) touching toes without flexing knees, (c) hands held in front; rasterstereography of children stretching hands above head in (d) frontal plane and (e) sagittal plane

Table 3 lists clothing for public-performance sessions, which may be watched by parents of both genders.

For training sessions students should be attired in white clothing to allow for recording and evaluation of gymnastic performance using digital-movement analysis (Trout, 2013) as well as stereophotogrammetric techniques (Figure 3a-e) — moiré fringe topography and rasterstereography (Kamal 2008; 2014). Moiré fringe topography provides height maps, normal to plane of the 2-D photograph, whereas rasterstereography provides curvature maps — a combination of

Table 3: Clothing for public-performance sessions

Setting	Boys	Girls
Boys should be wearing athletic supporter under briefs or figure-hugging half-pants		
Under 7		
Indoors	Briefs	Asymmetric leotard
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
Under 9		
Indoors	Briefs	Regular leotard
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
Under 11		
Indoors	Figure hugging half-pants	Regular leotard — with stockings
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	
11+		
Indoors	Figure hugging half-pants	Regular leotard — with stockings
Outdoors	During colder weather, extra clothing (coats, sweaters) for warm-up and cool-down activities	

Section A	$0 \leq P(h) + P(\mu) < 50$	Small Child	
Section B	$50 \leq P(h) + P(\mu) < 150$	Child of Medium Build	
Section C	$150 \leq P(h) + P(\mu) < 200$	Big Child	

Figures 4a-d: (a) Section assignment according to sum of percentiles of height $P(h)$ and mass $P(\mu)$; photographs of (b) a small child, (c) a child of medium build and (d) a big child

these techniques (Kamal *et al.*, 1996) would give true 3-D information. Light colours and designs may be allowed for public-performance sessions, so that outfits for different teams could be recognized. The training sessions are supposed to be conducted in restricted-audience setting, which means that only the instructor and the health team (doctor, physiotherapist, psychologist/psychiatrist, nurse and medical researcher) are allowed to be present in these sessions — no outsider is allowed to be present or remotely watch these sessions to protect privacy of students. Authorized members of the health team may watch the activities through one-way screen or video monitors, as part of their professional duties. Outdoors for training sessions are *secluded outdoors*, which are grassy, sandy and muddy patches, offering visual and acoustic privacy from strangers (restricted-audience setting), where the students exercise in minimal clothing to benefit from the soothing effects of sun rays, fresh air and contact of body with sand and mud.

Since gymnastic routines consist of physical exercises, sections are to be made according to heights and weights of students. Three sections are proposed depending on build of child determined from sum of percentiles of height and mass (Figure 4a). The shorter and the lighter students (small child: sum of height and mass percentiles falling in the range zero to 49.99999) should be grouped in Section A, whereas the taller and the heavier students (big child: sum in the range 150.00000 to 199.99999) get enrolled in Section C. The children of medium build (sum in the range 50.00000 to 149.99999) are sent to Section B. Depending on the number of students

enrolled, sections may be divided into sub-sections, *e. g.*, A1, A2, A3, ...; B1, B2, B3, ...; C1, C2, C3, Figures 4*b-d* show photographs of a small child (EP: SGPP-KHI-20081031-01/02; age 7 years 11 months; sum of percentiles 8.08; 34.98% obese), a child of medium build (RZAQ: SGPP-KHI-20080423-01/02; age 4 years 3 months 9 days; sum of percentiles 54.29; 15.97% obese) and a big child (RZA: 20080910-01/02; age 3 years 4 months 11 days; sum of percentiles 161.13; 13.81% wasted), selected from the children who are enrolled in Growth-and-Obesity-Monitoring Program in SF-Growth-and-Imaging Laboratory, percentiles of height and mass as well as status of obesity/wasting determined from the method reported in Kamal *et al.* (2011). The first one exhibits the phenomenon of under-nutrition (in extreme cases acute malnutrition), the second one energy-channelization problem and the last one over-nutrition, most of the time (Kamal *et al.*, 2014*b*; Kamal & Jamil, 2014).

The rationale for gymnastic-clothing may be extended to a wider range of physical activities, without compromising comfort, safety and hygiene considerations (Kamal & Khan, 2013). Adoption of such clothing becomes essential for rhythmic gymnastics and circus (which has routines of gymnastic-performance). Tree climbing and manoeuvring are the most primitive of gymnastic-activities. It should be interesting to note that *Tarzan* in nature movies, strictly, complied with the dress code suggested in this paper.



Figure 5: LG: SGPP-KHI-20131021-02/01; age 7 year 3 month 7 day; sum of percentiles of height and mass 125.68 (child of medium build); 7.59% tall; 10.28% wasted; exhibiting the phenomenon of energy channelization

DISCUSSION AND CONCLUSION

Childhood health and physical activity are strongly linked (Kahan, 2008). Gymnastics is a type of physical activity (movement of body resulting in energy expenditure), which requires the participants to be robust and dynamic (McKenzie & Kahan, 2008). Tall and wasted children (Figure 5), exhibiting the phenomenon of energy-channelization (Kamal *et al.*, 2014b; 2015), frequently, get selected in gymnastic teams. The authors, however, recommend that children more than 20% wasted, as determined by growth-and-obesity models (Kamal *et al.*, 2011; 2015), should not be allowed to participate, as they would not have enough energy required for the demanding gymnastic routines.

Teaching of gymnastics in primary schools comprises of aesthetic component, cognitive component, creative component, physical component, psychological component and skill component — with or without apparatus (Caroll & Manners, 2003). The content is classified into different units (often called ‘themes’): travelling or locomotion (motion of body center-of-mass), balance and rotation (motion about body center-of-mass), springing and landing as well as partner work. Safety and performance are issues that are at the forefront in selecting appropriate clothing for gymnastic activities. Tirloni & Moro (2010) studied clothing interference in performance, articular range of motion and comfort in labor gymnastics.

This paper gave hairstyle, clothing and footwear for gymnastic activities in primary-school setting. Enough flexibility in clothing is suggested so that conservative communities may, also, adopt these recommendations (Kahan, 2003). There is a need to accept and to accommodate the sensitivities and the reservations of people from different cultural backgrounds (Kahan, 2011). Many of the problems related to gymnastic- and sport-clothing, body image and preteen embarrassment would be bypassed by introducing gender-segregated classes. The different body

builds of two genders; the different activity-styles, the different rates of growth and development as well as the different administrative styles all suggest need for different curricula of gymnastic routines for boys and girls. The above argument is further supported by the fact that artistic routines in international competitions are different for males and females.

Below is a summary of recommendations for gymnastic clothing, to be adopted in the primary-school setting:

- Boys should be required to have very short hair. Girls should have long hair tied, using pony, in the form of (hair) bun.
- Gym clothing should neither be loose enough to get tangled into furniture or apparatus or fall over face during headstand, nor too tight (around thighs and at the waist) to prohibit free movement or cause irritation and heating of genital areas. It should be made of absorbent material and have elastic bands around waist and thighs to offer proper protection from exposure of private parts.
- Gym clothing should not have loose/fancy strings, straps or zippers.
- Silky clothing and underwear is not recommended, as it would slip from apparatus.
- Gym clothing should be plain white (for training sessions) and light-coloured with designs for public-performance sessions.
- Younger boys and girls are encouraged to train in briefs or knickers (panties) only, stripped-to-waist, leg exposed from upper thighs to feet; older boys may put on figure-hugging half-pants, ending just below knees, whereas older girls could dress in leotard, with stockings, whenever appropriate.
- Under-7 girls may wear asymmetric leotard, with dominant arm and neck area exposed, for public-performance sessions.
- Indoors, both boys and girls should be barefoot for gymnastics. When barefoot is not possible outdoors, they should put on clean pure-cotton socks and plimsolls (sneakers), both of them white in colour, after applying disinfectant powder on feet.

There is a need to establish state-sponsored gymnastic training centers, which take boys and girls from the age of 5 years and hold competitions for under-7, under-9, and under-11 students to bring out talent, allow exposure of these budding geniuses in the community and prevent marginalisation of physical activity over other subjects, in which the students are graded through

structured examinations (Laureano *et al.*, 2014). The Armed Forces of Pakistan should, also, come forward and patronize such activities in their schools and colleges. The first author had a chance to check fitness levels of children of servicemen in the schools run for their families during 1998-2008 and was, strongly, convinced that much should be done in order that these boys and girls were able to set examples for children of their civilian counterparts. Since 2011, he has been involved in height and weight monitoring as well as fitness testing in a civilian school on the basis of children's growth-and-obesity model published the same year (Kamal *et al.*, 2011) and extended during the subsequent years (Kamal & Jamil, 2012; Kamal *et al.*, 2014b) using Enhanced Growth Tables admitting height and mass percentiles below 3rd and above 97th percentiles (Kamal & Jamil, 2014). The students enrolled in gymnastic-training programs should maintain optimal weight-for-height using month-wise recommendations to gain height and reduce or pick up weight based on 'Growth-and-Obesity Roadmap' (Kamal *et al.*, 2013; 2014a; 2015). Such a policy should set Pakistan in the direction of producing Olympic champions in this important event.

REFERENCES

- Akram, M. & Kamal, S. A. (1991, April 16-20). Role of moiré fringe topography in the skeletal examination of school athlete. In: *The International Congress and Exposition on Sports Medicine and Human Performance*, p. 2, Vancouver, Canada, abstract#36: <http://www.ngds-ku.org/pub/confabst0.htm#C36>:
- American Academy of Pediatrics — Committee on Sports Medicine. (1982). Climatic heat stress and the exercising child. *Pediatrics*, 89 (6), 808-809
- Atkinson, R. L., Atkinson, R. C. & Hilgard, E. R. (1981). *Introduction to Psychology*, p. 128; chapter 4: Sensory Processes — Skin Senses, 8th Ed. San Diego, California, United States: Harcourt Brace Jovanovich
- Burton, E. C. (1977). *The New Physical Education for Elementary School Children*, chapter 4, Boston, Massachusetts, United States: Houghton Mufflin
- Caroll, M. E. & Manners, H. K. (2003). *Gymnastics 7-11: A Session-by-Session Approach to Key Stage 2*, pp. 2-5; chapter 1: Introduction — Key Stage 2, e-Ed. London, UK: The Falmer Press & Philadelphia, Pennsylvania, United States: Taylor & Francis
- Curtis, H. S. (1922). Athletics and the children's clothes. *American Physical Education Review*, 27 (5), 224-227
- Health Smart. (2013, January). The three-minute sleep fix. *Reader's Digest (Asia)*, 100 (599), 11

- Joseph, L. H. (1949, Mar-Apr). Gymnastics in the pre-revolutionary eighteenth century, *CIBA Symposia*, 1054-1060
- Kahan, D. (2003). Islam and physical activity: Implications for American sport and physical educators. *Journal of Physical Education, Recreation & Dance*, 74 (3), 48-54
- Kahan, D. (2008). Recess, extracurricular activities and active classrooms. *Journal of Physical Education, Recreation & Dance*, 79 (2), 26-31, 39
- Kahan, D. (2011). AAA roadmap for navigating religion in physical education. *Strategies*, 24 (4), 20-24
- Kamal, S. A. (1996a). A 3-D-static model of the human spinal column. *Karachi University Journal of Science*, 24 (1), 29-34; full text: <http://www.ngds-ku.org/Papers/J18.pdf>
- Kamal, S. A. (1996b, June 27-July 11). 3-D-dynamic modeling of the human spinal column. In: *The Twenty-First International Nathiagali Summer College on Physics and Contemporary Needs (INSC 1996)*, Nathiagali, KP, Pakistan; abstract: <http://www.ngds-ku.org/pub/confabst0.htm#C42>:
- Kamal, S. A. (2008, December 20-23). Role of mathematics in sports sciences and technologies. In: *The Thirty-Fifth All Pakistan Science Conference (Genomics for Health and Prosperity)*, p. 75, Karachi, Pakistan: University of Karachi; *Karachi University Journal of Science*, 36 (1&2), 5; abstract#72: <http://www.ngds-ku.org/Presentations/Sports.pdf>
- Kamal, S. A. (2014, May 17). Sports and anthromathematics. In: *The Fifty-Fifth Annual Prize Distribution Function*, Hyderabad, Pakistan: Government College (seminar); abstract: http://www.ngds-ku.org/Presentations/Sport_Mathematics.pdf
- Kamal, S. A., Ansari, S. A. & Jamil, S. S. (2014a, September 4). Growth-and-Obesity Enhanced-Roadmaps of children. Concluding talk in: *The Second Conference on Anthromathematics and Sport Mathematics in the Memory of (Late) Hussain Ahmed Bilgirami (ANTHROMATHEMATICS 2014)*, p. 10, Karachi, Pakistan: Department of Mathematics, University of Karachi, and Hyderabad, Pakistan: Government College; abstract#Anthro14-06: <http://www.ngds-ku.org/Presentations/Enhanced.pdf>
- Kamal, S. A., Ansari, S. A. & Jamil, S. S. (2015). Generating and validating Growth-and-Obesity Roadmaps for the Pakistani children. *International Journal of Biology and Biotechnology*, 12 (1), 47-61; full text: <http://www.ngds-ku.org/Papers/J35.pdf>
- Kamal, S. A., Choudhry, A. S. & Siddiqui, Y. A. (1996). Gait analysis using moiré fringe topography and raster-stereography (simultaneous recording). *Karachi University Journal of Science*, 24 (2), 7-18; full text: <http://www.ngds-ku.org/Papers/J16.pdf>
- Kamal, S. A., Jamil, N. & Khan, S. A. (2011). Growth-and-Obesity Profiles of children of Karachi using box-interpolation method. *International Journal of Biology and Biotechnology*, 8 (1), 87-96; full text: <http://www.ngds-ku.org/Papers/J29.pdf>
- Kamal, S. A. & Jamil, S. S. (2012). A method to generate growth-and-obesity profiles of children of still-growing parents. *International Journal of Biology and Biotechnology*, 9 (3), 233-255; full text: <http://www.ngds-ku.org/Papers/J30.pdf>
- Kamal, S. A. & Jamil, S. S. (2014). KJ-regression model to evaluate optimal masses of extreme cases. *International Journal of Biology and Biotechnology*, 11 (4), 623-648; full text: <http://www.ngds-ku.org/Papers/J34.pdf>
- Kamal, S. A., Jamil, S. S. & Ansari, S. A. (2013, September 4, 5). Growth-and-obesity roadmaps of children. In: *The First Conference on Anthromathematics in the Memory of (Late) Syed Firdous (ANTHROMATHEMATICS 2013)*, p. 8, Karachi, Pakistan: Department of Mathematics, University of Karachi, and Hyderabad, Pakistan: Government College; abstract#Anthro13-02: <http://www.ngds-ku.org/Presentations/Roadmap.pdf>
- Kamal, S. A., Jamil, S. S. & Razzaq, U. A. (2014b). Stunting induced by wasting — wasting induced by stunting: A case study. *International Journal of Biology and Biotechnology*, 11 (1), 147-153; full text: <http://www.ngds-ku.org/Papers/J32.pdf>
- Kamal, S. A. & Khan, S. A. (2013, September 4, 5). Fitness for primary-school children. In: *The First Conference on Anthromathematics in the Memory of (Late) Syed Firdous (ANTHRO-MATHEMATICS 2013)*, p. 24, Kara-

- chi, Pakistan: Department of Mathematics, University of Karachi, and Hyderabad, Pakistan: Government College; abstract#Anthro13-18: <http://www.ngds-ku.org/Presentations/Fitness.pdf>
- Kamal, S. A. & Khan, S. A. (2014). Primary-physical-education practices in Pakistan and England: Health and safety perspectives. *International Journal of Biology and Biotechnology*, 11 (2&3), 401-419; full text: <http://www.ngds-ku.org/Papers/J33.pdf>
- Kamal, S. A. Naseeruddin, Wasim, M. & Firdous, S. (1998). Physics of scoliosis screening in school-going children. *Karachi University Journal of Science*, 26 (1), 5-12; full text: <http://www.ngds-ku.org/Papers/J22.pdf>
- Kamal, S. A., Sarwar, M. & Rajput, M. K. (2012, December 27-29). Crystal-structure concepts applied to static and dynamic modeling of the human spinal column. In: *The International Conference on Condensed-Matter Physics and Engineering*, p. 18, Multan, Pakistan: The Bahauddin Zakaria University; abstract: <http://www.ngds-ku.org/Presentations/BZU1.pdf>
- Kirchner, G. (1970). *Physical Education for Elementary School Children*, 2nd Ed. Dubuque, Iowa, United States: William C. Brown
- Laureano, J., Konukman, F., Gümüşdağ, H., Şamil Erdoğan, S., Jong-Hoon Yu, J. H. & Çekin, R. (2014). Effects of marginalization on school physical education programs: A literature review. *Physical Culture and Sport. Studies and Research*, 64 (1), 29-40
- McKenzie T. L. & Kahan, D. (2008). Physical activity, public health and elementary schools. *The Elementary School Journal*, 108 (3), 171-180
- Ministry of Education and Central Office of Information. (1952). *Physical Education in the Primary School: Part One — Moving and Growing*, plates 2-4, London, UK: Her Majesty's Stationery Office
- Ministry of Education and Central Office of Information. (1953). *Physical Education in the Primary School: Part Two — Planning the Programme*, London, UK: Her Majesty's Stationery Office
- Russell, J. (1975). *Creative Movement and Dance for Children*, pp. 28-32, plates 8-16, Boston, Massachusetts, United States: Plays
- Signy, H. (2012, February). The baby, who was loved back to life. *Reader's Digest (Asia)*, 98 (588), 86-93 (ideas summarized from the box on p.91: Our bodies are programmed to respond to touch)
- Tirloni, A. S. & Moro, A. R. P. (2010). Interferência do vestuário no desempenho, na amplitude de movimento e no conforto na ginástica laboral (Clothing interference in performance, articular range of motion and comfort in labor gymnastics). *Revista Brasileira de Cine-antropometria e Desempenho Humano (Brazilian Journal of Kinanthropometry and Human Performance)*, 12 (6), 443-450
- Trout, J. (2013). Digital movement analysis in physical education. *Journal of Physical Education, Recreation & Dance*, 84 (7), 47-50
- Tuckson, R. V. (2013). America's childhood obesity crisis and the role of schools. *Journal of School Health*, 83 (3), 137, 138
- Vendien, C. L. & Nixon, J. E. (1968). *The World Today in Health, Physical Education and Recreation*, p. 144; plate — third grade group work in gymnastics, Englewood Cliffs, New Jersey, United States: Prentice-Hall
- Authors' Note:** The authors are indebted to Laura Clinton, Physical Education Teacher in East Anglia, England for extensive discussions regarding teaching of gymnastics in the primary-school setting of England. Thanks are, also, due to authorities of Army Public School, 'O' Levels (serving children of personnel of Pakistan Army), Bahira College, NORE I (serving children of personnel of Pakistan Navy), Beacon Light Academy (serving children of civilian population) and Fazaia (PAF) Degree College (serving children of personnel of Pakistan Air Force), all of them located in Karachi, Pakistan for allowing the NGDS Team (<http://ngds.uok.edu.pk>) to collect data on their premises. No potential conflict of interest is identified for this work.

Web address of this document (on first author's homepage): <http://www.ngds-ku.org/Papers/J37.pdf>

Abstract: <http://www.ngds-ku.org/pub/jourabstB.htm#J37>: